Examining the Economic Costs of Vaccine Nationalism in the COVID-19 Pandemic

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Introduction:

On December 8th, 2020, a British citizen received the world's first Pfizer/BioNtech (Pfizer) COVID-19 vaccine nearly a year after human variants of SARS-CoV-2 had been identified in patients in Wuhan, Hubei, China (Nishiura, 330). As of August 27th, 2021, approximately 5.13 billion Coronavirus vaccines have been administered at a rate of over nearly 36.1 million doses a day, fully vaccinating around 5 percent of the global population (Bloomberg). However, 40 percent of all vaccinations have occurred in the 27 wealthiest nations, vaccinating their populations 25 times faster than lower income countries. Under existing supplier contracts the UK, USA, and several other high-income countries have ordered enough doses to vaccinate more than 250% of their total population (Bloomberg)

This paper will seek to understand impact of vaccine hoarding on vaccine distribution through statistical comparisons between countries with varying levels of access to vaccine doses. This analysis will be done on two country pairs which are geographically and economically similar, but in different stages of a vaccine rollout, to quantify the effects of lack of vaccines access on both economic and pandemic factors. The findings of this analysis will provide a better picture of how vaccine distribution has propelled, or hindered, their national economies. To provide background to these findings the paper will look to examine the different access mechanisms currently available to secure vaccine doses, while also outlining issues that have stemmed from these approaches.

Section 1: Vaccine Access Mechanisms

As of August 2021, two mechanisms have been utilized by countries to secure COVID-19 vaccine doses: private contracts or membership in the COVID-19 Vaccine Global Access Program (COVAX). Most high-income nations have opted to secure private contracts with producers, with varying degrees of success. This private-contract mechanism consists of several integral stages: contracts, emergency use authorization, manufacturing, and final distribution. Currently most country-specific contracts have been secured with vaccine producers Pfizer, Moderna, and AstraZeneca, delivering vaccines to countries like the US, UK, and Canada. To arrange an Advance Purchase Agreement (APA) a country must approach a producer like Pfizer to preorder doses, allowing time for adequate numbers of cell cultures to be cultivated for future production (Phelan, 800). As each producer has a limited production capacity, soft power, and ability to fund production play a large role in this process. After the doses have been produced countries rely on networks of fill and finish facilities to manufactory export-ready vaccines for national distribution. However, this mechanism is accessible only to the select few. As of June 2021 84%, of wealthy nations have had access to, and carried through with, an APA with Pfizer, however no lower-middle-income or low-income nations have been able to successfully compete for these contracts till February of 2021 (Bollyky, 5).

Countries unable to bid for APAs with producers have instead turned to COVAX, a global vaccine access program run by the WHO, UNICEF, and Coalition for Epidemic Preparedness Innovations (CEPI) (The Lancet, 941). COVAX's goal is to give equitable access to available vaccines, stating that "protecting health care workers and those most-at-risk is the only way to mitigate the public health and economic impact of the pandemic". COVAX faces a difficult task as over 90% of the populations in low and medium-income countries are in rural areas, far from health centers equipped to effectively distribute doses (Chakraborty, 2). Production of COVAX ordered vaccines has been tasked to Indian companies, notability the Serum Institute of India, while distribution has begun through WHO, UNICEF, and recipient governments (Bollyky, 4). Initial funding in February 2021 for these efforts was provided through a $7.5 billion pledge from the US and G7 but included none of the 4.3 billion doses secured at that time by Australia, Canada, and numerous other wealthy nations (Evenett, 18). Beginning summer 2021 some countries have begun donating overflow doses to the program, with the US pledging 44 million vaccines to the program in June.

Section 2: Vaccine Nationalism and the Vaccine Production Club

As APAs became available during the summer of 2020 wealthier nations quickly secured contracts: adding up to a total of over 4.3 billion doses, more than three times their total population. (Evenett, 18). By February of 2021 60% of all APAs belonged to a group of just 13 countries, evidencing an ever-growing issue: Vaccine nationalism. Vaccine nationalism can be defined as "the prioritization of the domestic needs of the country in an outlay of others" (Lagman, 1). The dangers of this vaccine hoarding are very real; if only a select group of countries can fully vaccinate its population the virus will continue to thrive and mutate in unvaccinated communities. Even if nations can fully vaccinate their citizens, further mutations could render any vaccination plans completely useless (Anjum, 2371). A minimum of 70% of the global population must receive a two-dose vaccine to reach herd immunity, but more than 80% of the population of low-resource areas will not have access to vaccines in 2021 (Katz, 1281).

This issue can be attributed to a group of 13 countries: Argentina, Australia, Brazil, Canada, China, the European Union, India, Japan, Korea, Russia, Switzerland, UK, and US. These countries are completely self-reliant in the production and distribution of vaccines, aptly nicknamed "The Vaccine Production Club" (Roghani). This Vaccine Club currently holds 60% of APAs and is home to the headquarters of all companies producing EUL approved vaccines, as well as 91% of their subsidiaries (Evenett, 2). As a result of these factors global sourcing, production, and distribution of vaccinations has become circular in nature; currently 10 companies produce effective vaccines, and all are in at least one of the 13 countries. Pfizer, Johnson & Johnson, and Novarax are headquartered in the US, AstraZeneca in the UK, and Curevac, Medicago, and Sinovac are all located within the Vaccine Club (Evenett, 16). The inter-dependence of the club extends to the ingredients needed to manufacture the vaccines, with over 70% of the 444 manufactures of key ingredients located in the EU, US, China, and India (Park, 1). Furthermore, vaccine producers import 68% of their supplies from within the vaccine club, growing a dependence between countries like the US and the EU bloc (Evenett, 2).

The vaccine nationalism exhibited by the vaccine club has a direct impact on the state of the pandemic in the global south. While COVAX membership and vaccine donations can help deliver doses to these regions, sufficient vaccinations can only be reached if production capabilities and resource access are expanded. These low-income countries are already more vulnerable due to greater healthcare stress to public resources, worsened by "unemployment, hunger, malnutrition, lack of healthcare, and economic crises" (Chakraborty, 165). These issues are magnified by the relationship of extraction that has developed during the pandemic between the vaccine club and the global south, with over 40 vaccine trails taking place in these countries but no actual agreements being drawn to supply these nations with doses (Bump, 2). Until the questions of vaccine APA access, effective distribution, and challenges of vaccinating rural communities are answered the global south will continue to slow the path to global heard immunity (Acharya, 9).

Section 3: Background to Case Study on Vaccine Response

To determine the extent of the effects of vaccine nationalism this analysis will examine two country pairs: Canada and the UK and Chile and Brazil. These pairs represent countries that are physically and culturally similar, while haven undergone drastically different vaccine rollouts throughout the throughout the first 6 months of the pandemic. Through these comparisons conclusions will be able to be drawn about the connections between the rate or level of vaccine rollout and economically significant factors such as unemployment and lockdown stringency. The lack of representation of developing nations in these pairings are due to the varying political, healthcare-access, and geographical issues present in some of these nations, which make pairings and accurate comparisons challenging. E.g., Mexico and Spain both have a GDP of around $1.2 trillion but differ greatly in their political climate and access to healthcare. These models aim to discover if there is a clear quantitative connection between vaccine rollout and the economic health or recovery of countries.

The pairs are based on their similarity in GDP per capita, Gini Coefficient, and Healthcare Access and Quality Index (HAQ). While these specific indicators are not completely identical, their similarity can show the effects of access to sufficient vaccinations or moreover a lack thereof.

Indicator	**Canada**	**UK**	**Chile**	**Brazil**
GDP per capita	$51,713	$47,089	$24,928	$15,643
Gini Coefficient	33.3	34.8	44.4	53.9
HAQ Index	87.60	84.60	76	64.9

Source: IMF, World Bank, and Fullman, 2018

Section 4: Canada and the UK

Canada and the UK's COVID experience have had similar approaches to lockdown, vaccination rollouts, and economic response to the pandemic. However, the biggest difference between the two is how a delayed vaccination distribution can hinder a full economic recovery. In March of 2020 both Countries went into full lockdown, with Canada going a step further to ban entry to all non-residents including most visa-holders. By late April Canada and the UK were in complete lockdown, staying that way until the first wave of infections passed in late summer 2020. Both countries engaged in a series of circuit-breaker lockdowns, temporarily entering full-lockdown to slow case spreads during the summer of 2020 (Detsky, 43) (Baraniuk, 1780). Both Canada and the UK are part of the Vaccine Production Club, having already secured APAs with Pfizer, AstraZeneca, and Moderna in December of 2019.

Figures 1 and 2 show the link between reporting of new COVID cases reported per day and the level of the "Stringency Index", a COVID response index created by the Oxford Coronavirus Response Tracker (OxCGRT). OxCGRT's index uses nine metrics to measure the relative strictness of COVID-precautions on the government level on a scale of 0 to 100. Figures 1 and 2 show cases and index values from the first four months of the pandemic, February to May, which can also be labeled as the first wave.

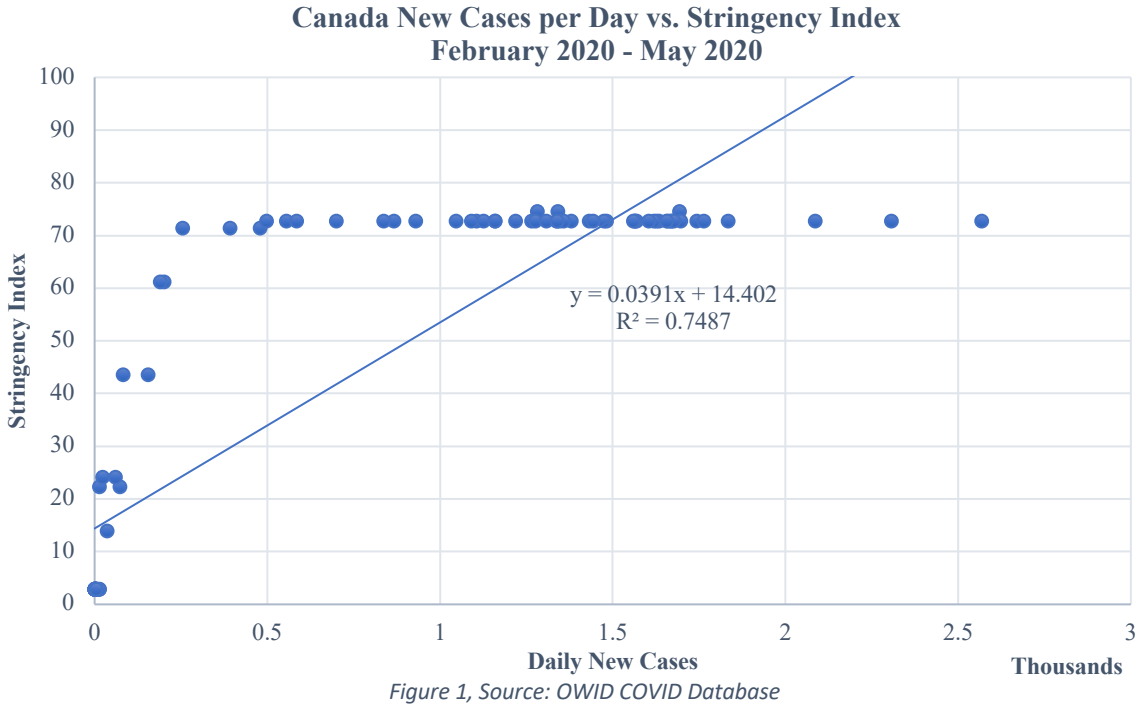

Figure 1, Source: OWID COVID Database

Figure 1's R^2 (Coefficient of Determination) of 0.7487 demonstrates that there is a strong link between the number of cases and stringency of lockdown measures in Canada. The leveling-off of index numbers in relation to cases can be explained by the consistent lockdown level present in Canada from March onwards.

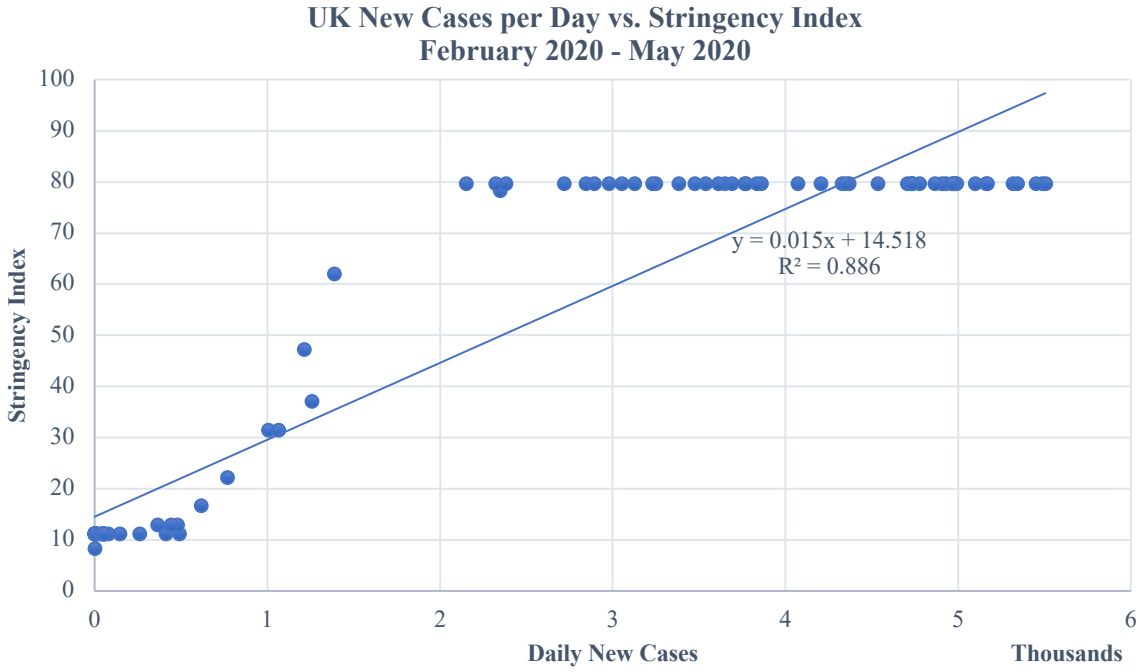

Figure 1, Source: OWID COVID Database

Figure 2 shows a similar relationship between the variables with a R^2 of 0.886 produced by the regression. While only beginning in early April the level of stringency also plateaus as the UK reached full lockdown. Figures 3 and 4 demonstrate the relationship between the severity of the pandemic and unemployment. Unemployment rate plays a major role in the output of an economy, drastically affecting purchasing power, employee morale, and the disposable income of families (Blustein). While output gap or other indexes could also be examined, the monthly frequency of the unemployment rate and its relative immunity to temporary relief from lockdown pressure in-between waves make it an ideal measure of national economic productivity during the pandemic.

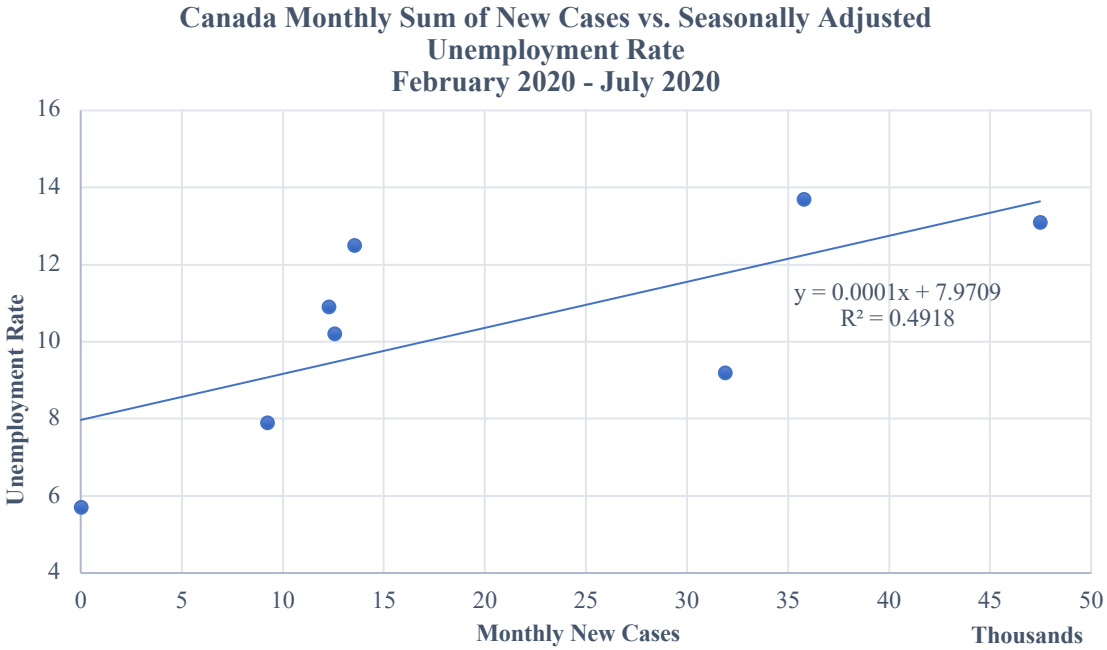

Figure 2, Sources: OWID COVID Database, StatCan, Labor Force Survey

Figures 3 and 4 do not show high R^2 values as they do not fit a linear model, however it can be observed that generally a higher number of cases or stringency index, the higher the unemployment rate in the first wave of the pandemic. The number of cases does not follow a completely linear relationship with the level of lockdown, but in the initial stages of the first wave more cases rapidly increased unemployment. The UK's unemployment rate spiked over a period 5 months longer than Canada's due to the existence of

the government furlough scheme, which meant workers were temporarily employed before being made redundant (Mayhew).

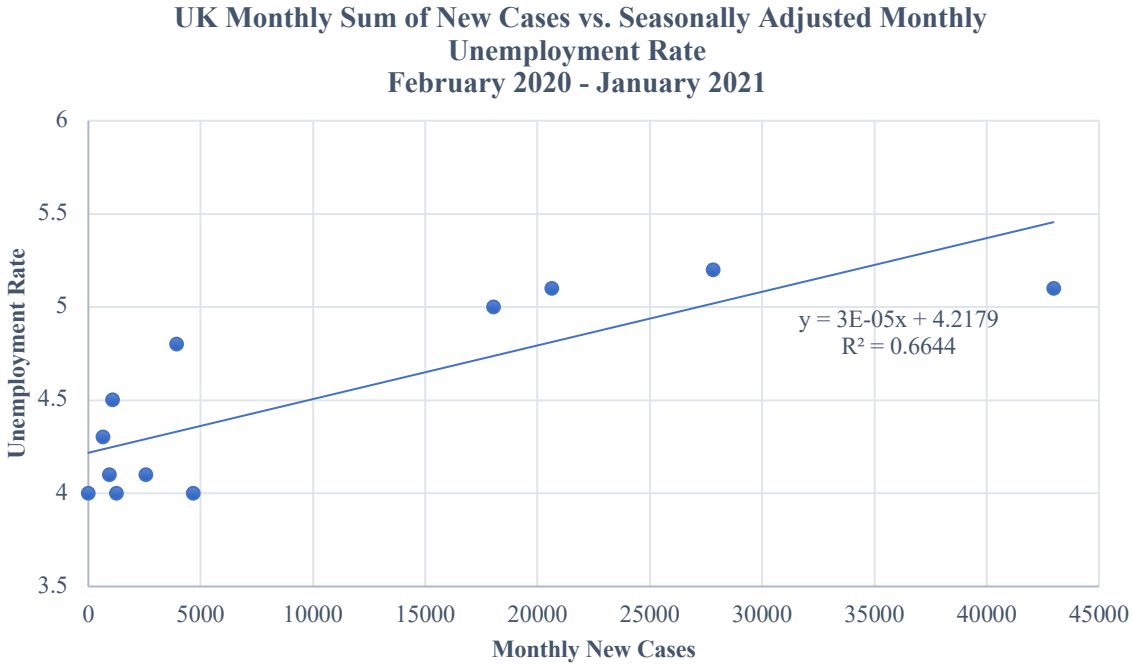

Figure 3, Source: OWID COVID Database, ONS

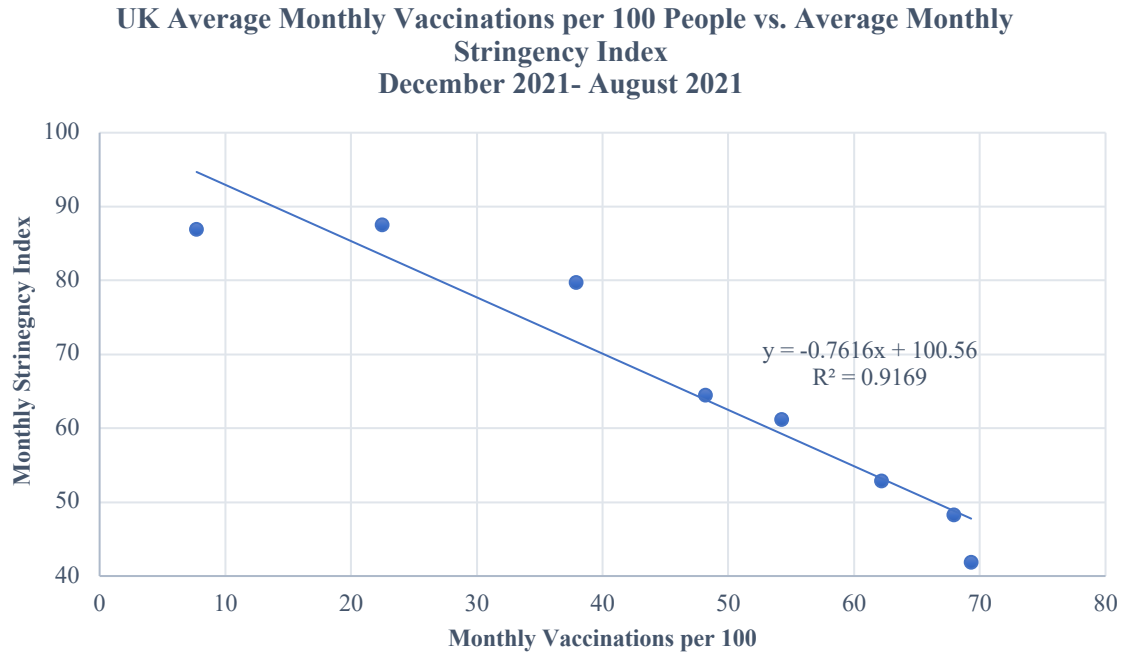

Figure 4, Source: OWID COVID Database

In December of 2020 the first vaccines reached the UK, with the first doses been administered mid-December to vulnerable populations. Comparatively the UK had one of the earliest comprehensive vaccination programs, with Canada reaching an equal vaccination rate only later in the summer. Figure 5 demonstrates a clear linear relationship between UK vaccination rates and the level of lockdown, with a R^2 of 0.9169. The more people vaccinated, the more open the economy became.

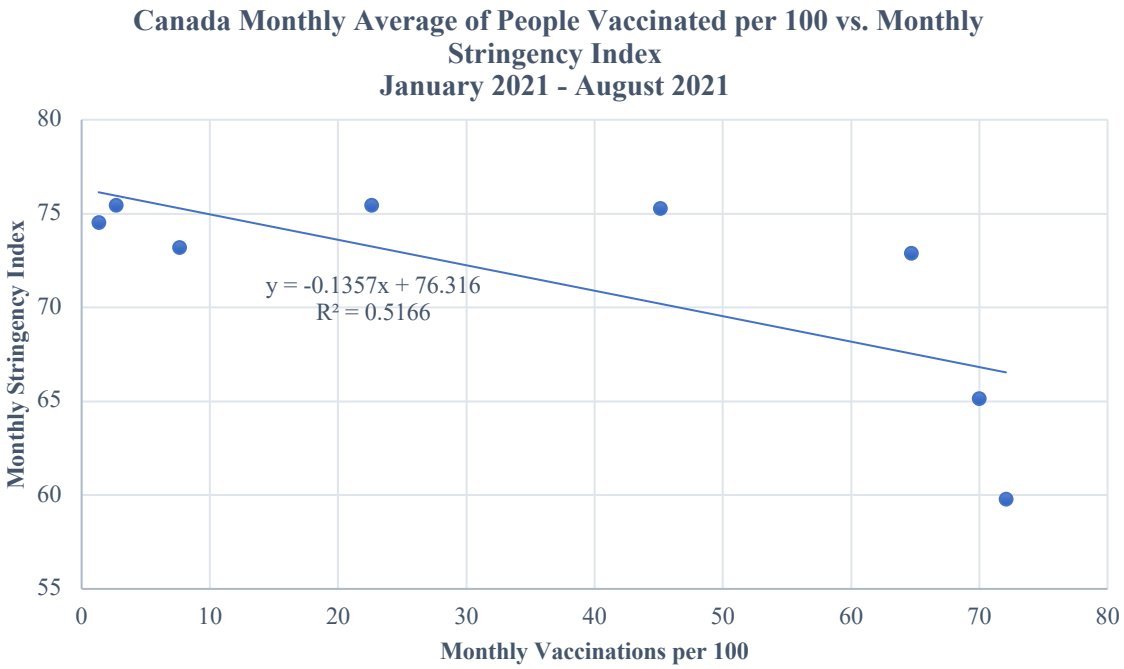

Figure 5, Source: OWID COVID Database

While figure 6 demonstrates a similar relationship to figure 5, the R^2 is much smaller. This delay can be attributed to Canada's initially slow vaccination program due to a delay in APA finalization and dose delivery in addition to Prime Minister Trudeau's far more conservative lockdown approach. With the UK further along in its re-opening one can also see a clear link between the vaccinations and levels of unemployment, demonstrated by figure 7.

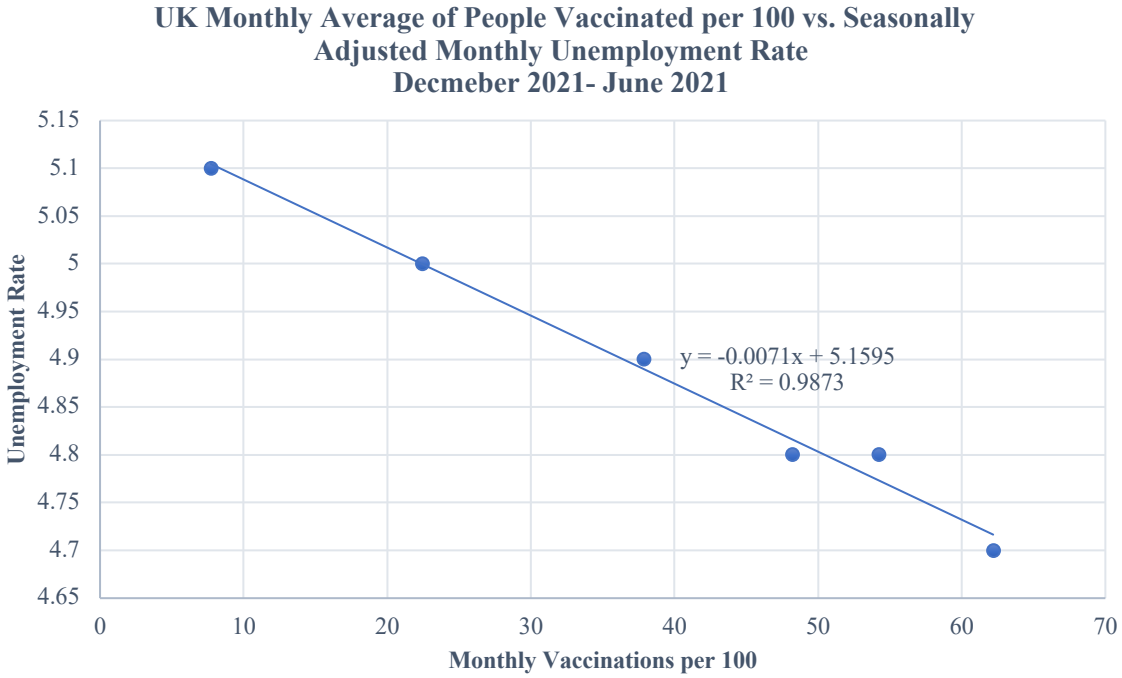

Figure 6, Source: OWID COVID Database, ONS

Section 5: Chile and Brazil

Chile and Brazil represent a very different side of the COVID pandemic compared to the UK and Canada. These countries have significantly higher income inequality and lower access to quality healthcare. COVID cases were first reported in late March and in both countries, with cases rapidly rising throughout the spring. Brazil has the second highest death toll from COVID in the world: around 579,000 deaths as of August 2021, with many going unreported due to inadequate testing measures and facilities (Kupek). In late

2020 Chile recorded the sixth largest number of cases in the world (Bloomberg). Chile and Brazil have however differed greatly in their vaccination programs, with Chile having organized one of the first nationwide vaccination programs in the world. Having secured several APAs, mostly with China's SinoVac program, the country vaccinated more than 25% of its population by March of 2021(Baraniuk).

Figures 8 and 9 picture the relationship between daily new COVID cases and the Stringency index for each country, demonstrating that a higher number of cases led to a higher level of national lockdown. As seen in figure 8 Chile instantly implemented, and subsequently maintained lockdown measures during the first wave of cases in 2020. Figure 9 shows a similar relationship with Brazil keeping a stringency index of around 80 from 5000 cases onwards.

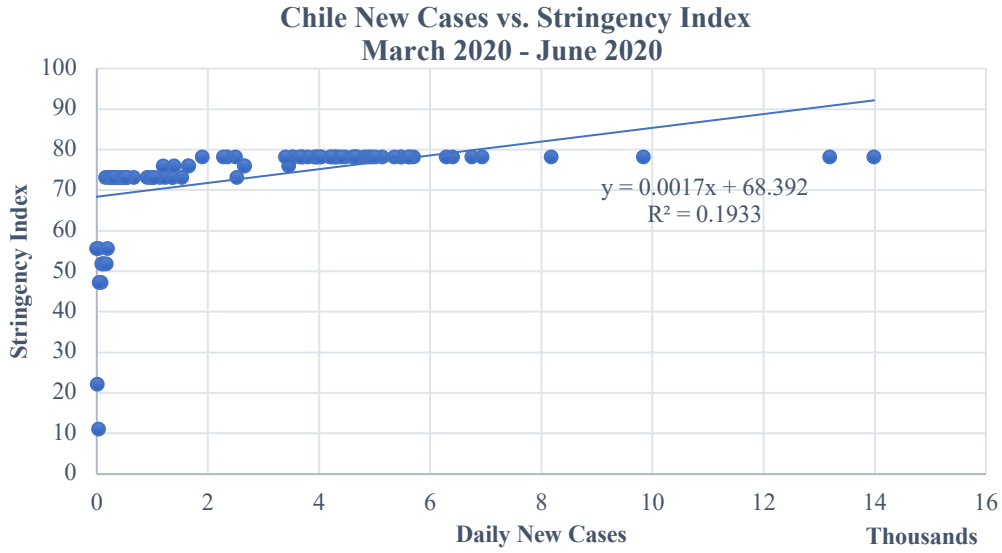

Figure 7, Source: OWID COVID Database

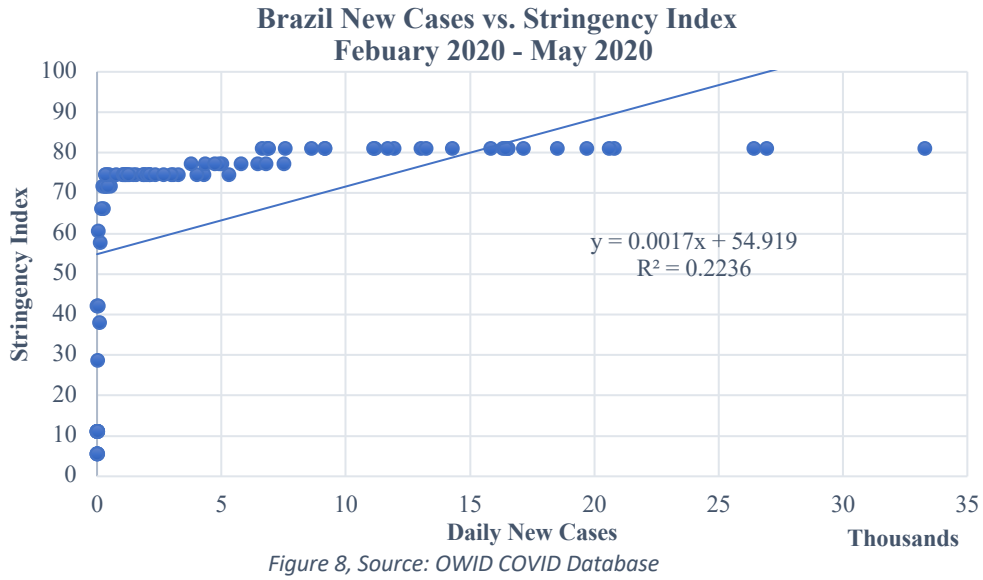

Figure 8, Source: OWID COVID Database

Figures 10 and 11 graph the relationship between Chile and Brazil's monthly new cases and unemployment rate, showing each country's entry into recession-level rates throughout the first half of 2020. Figure 10 does not show a clear linear relationship between the variables but a display a general upwards trend of unemployment in relation to new cases. The two outliers, colored red, can be explained by the premature loosening of lockdown measures upon first vaccine delivery (Bennett). Figure 11 shows Brazil following a similar trend, but with a much stronger R^2 of 0.6931.

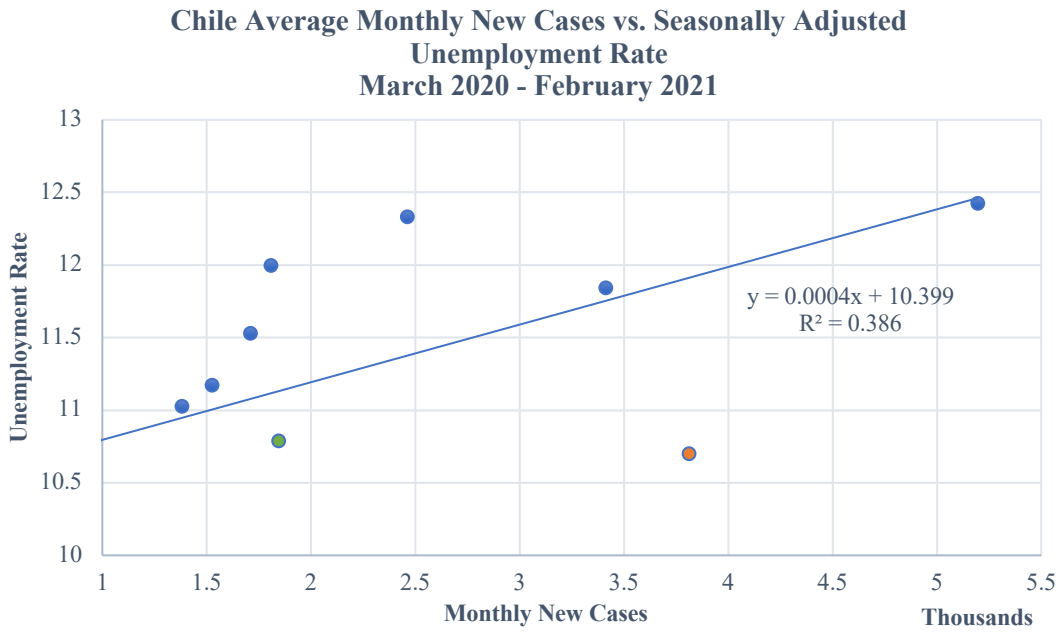

Figure 9, Source: OWID COVID Database, National Institute of Statistics

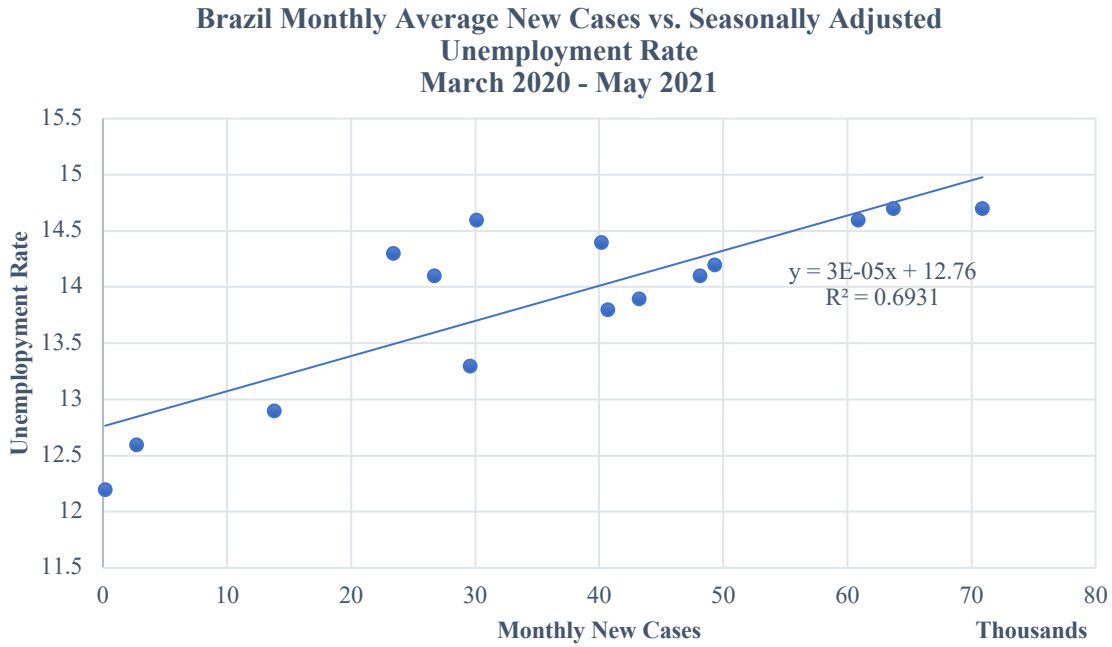

Figure 10, Source: OWID COVID Database, IBRC

Compared most South and Central American nations Chile was among the first countries to secure APAs for vaccine doses, resulting in the first batch of vaccines to be delivered in early January 2021 (Farzan). In late February of 2021 vaccinations began being administered to the public. Figure 12 graphs the relationship between the amount of people vaccinated per hundred and the stringency index, however the relationship is not statistically significant as Chile has maintained a strict lockdown even with growing vaccination numbers. The point highlighted in red is from August 2021, the first real shift in lockdown stringency since the beginning of Chile's lockdown.

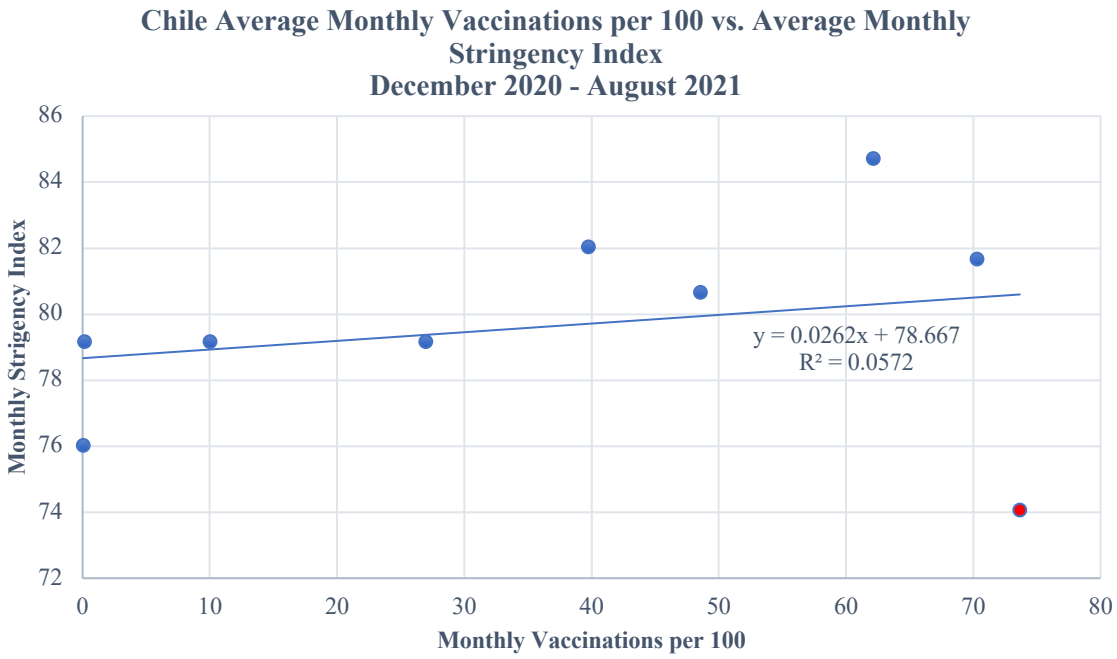

Figure 11, Source: OWID COVID Database

For Chile the relation of stringency index to vaccination numbers is not a good indicator of vaccinations impact on economic recovery, but the unemployment rate paints a much clearer picture. As seen in figure 13, with an R^2 of 0.9068, there is a clear linear relationship between increasing vaccinations and the unemployment rate. Furthermore, as demonstrated in figure 14 with an R^2 of 0.9484, when plotting vaccinations against Chile's Monthly Economic Activity Index (IMACEC) more vaccinations lead to a quicker recovery of economic output.

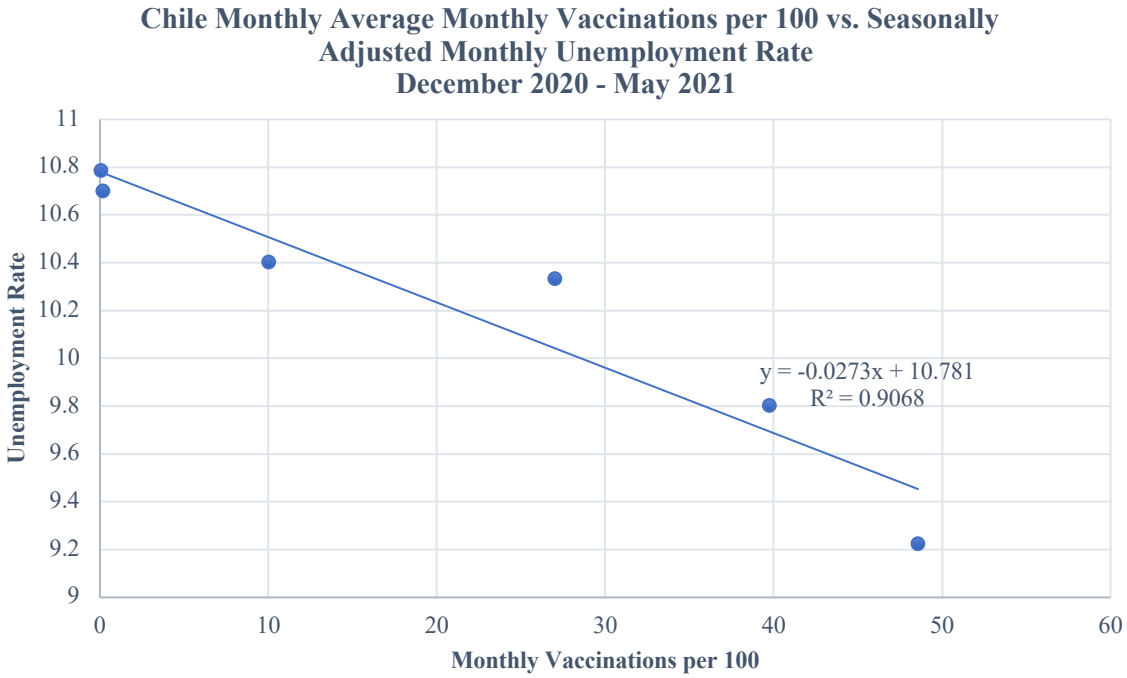

Figure 12, Source: OWID COVID Database, National Institute of Statistics

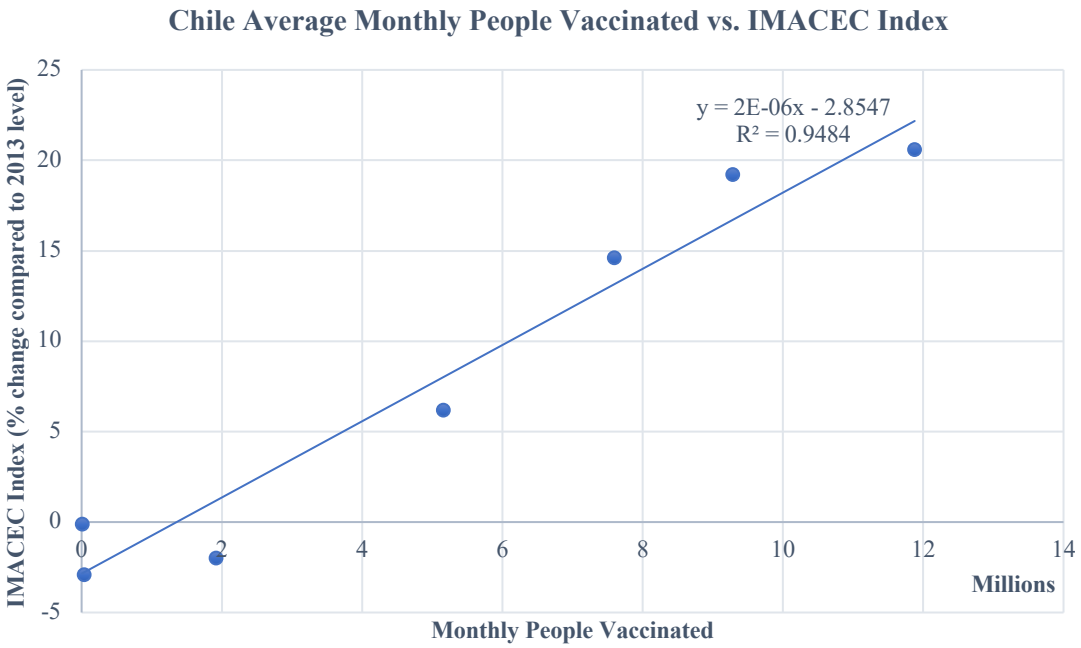

Figure 13, Source: OWID COVID Database, National Institute of Statistics

As Brazil only received its first sizeable vaccine deliveries in late January 2021 the rate, and therefore impact, of vaccinations has yet to reach the level of their Chilean neighbors (Kupek). However, as seen in figures 15 and 16 there is already a quantifiable impact being made by the preliminary waves of vaccinations.

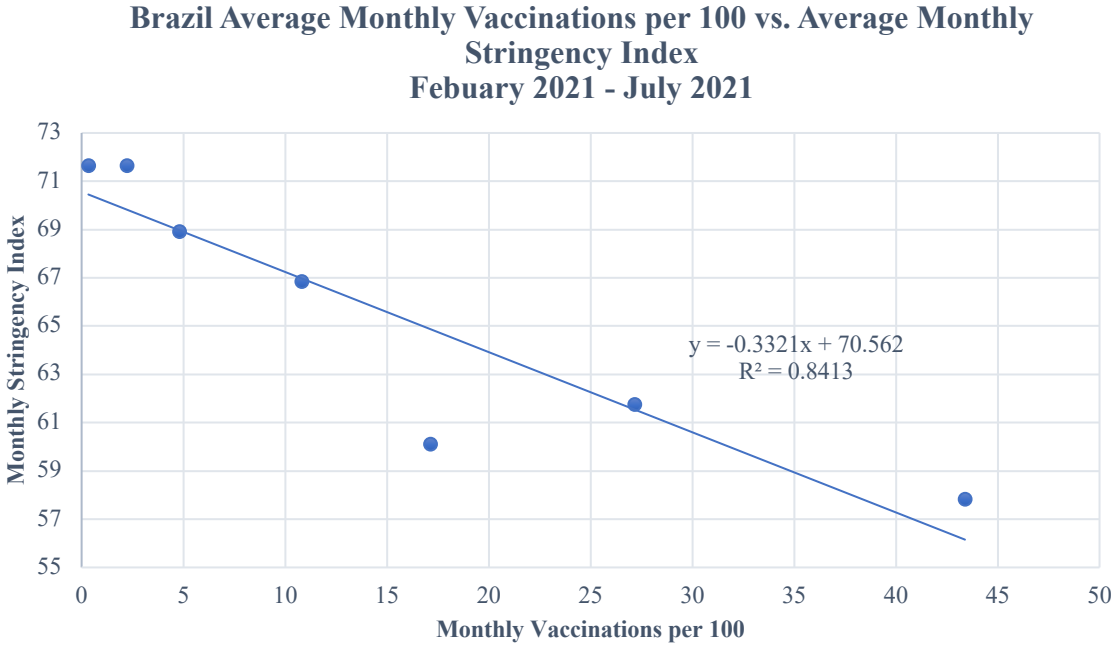

Figure 14, Source: OWID COVID Database

Figure 15 reveals an R^2 of 0.8413. showing that as vaccinations increased in Brazil since February of 2021 the stringency of lockdown has steadily decreased. Figure 16 backs this conclusion by graphing a similar relationship between vaccination numbers and unemployment, but still not as statistically significant as Chile's identical comparison in figure 14.

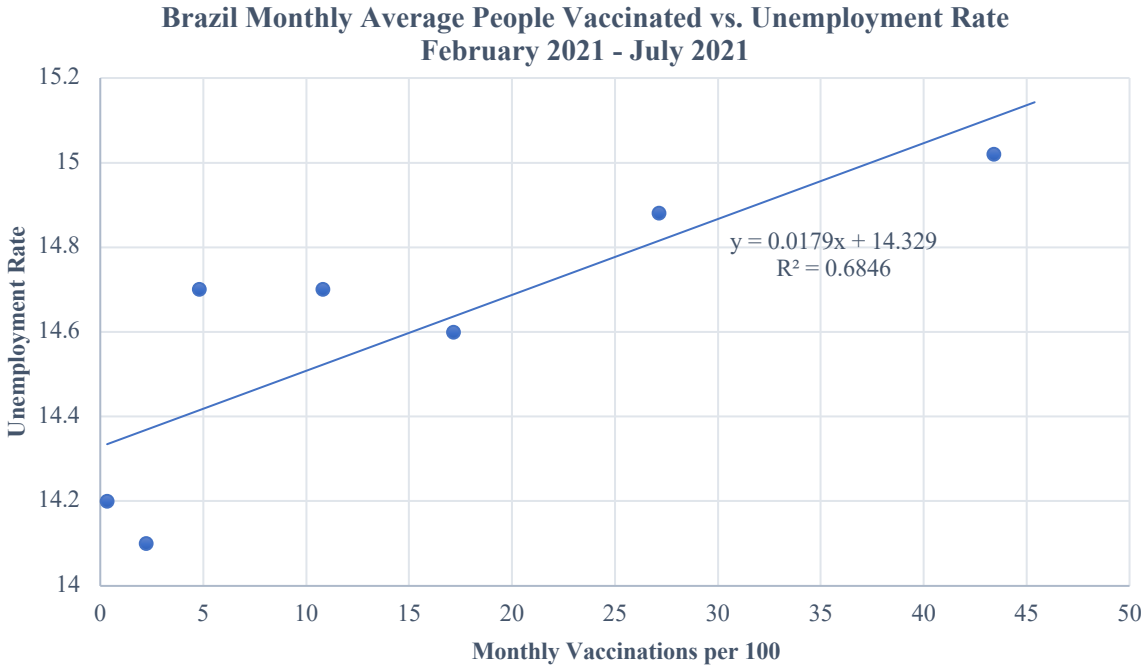

Figure 15, Source: OWID COVID Database

Section 6: Summary of findings, conclusion, and acknowledgements

Through the statistical analysis of vaccinations impact on Canada, the UK, Chile, and Brazil's pandemic timeline in the case study several key conclusions can be reached:

1. The higher the amount of COVID cases in a population, the higher the OxCGRT Stringency Index will become
2. The higher the amount of COVID cases are in a population, the higher the unemployment rate will be if the stringency index is kept at a consistent level
3. There is not a clear relationship between stringency index and monthly vaccinations as this is dependent on how risk-averse a government is with lockdown precautions
4. The higher the number of vaccinations in a population, the lower the stringency index will become
5. The higher the number of vaccinations in a population, the lower the unemployment rate will become over time
6. Higher vaccination rates generally coincide with a more rapid re-opening of an economy

While the amount of data currently available on vaccinations is scarce, these key conclusions already outline several essential observations for the next steps in this global pandemic. The more vaccines available to a country, the quicker it will be able to reopen its economy and spur the recovery from the COVID-induced recession (Hafner). However, if the same 13 nations still maintain the insular economy that is COVID vaccine production, this will be not only impossible but also increasingly risky to the world both from an economic and health perspective.

Any vaccine advancements in the developed world will be made irrelevant if COVID is continually able to spread throughout the developing world, subsequently developing new, vaccine-resistant, strains. The two access mechanisms outlined in section 2 enable vaccine nationalism as influence, paywalls, and exclusiveness make consistent vaccine supplies challenging for the global south. While nations like the US or China have opted to use their spare doses as political bargaining power, a truly effective system to distribute these vital doses is as of now is full participation in the COVAX program. While the analysis and case study done by this paper belongs to the early stages of vaccine-related literature, it stands to add to the growing number of academic perspectives on the rapidly worsening issues surrounding vaccine nationalism.

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